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AUTHOR Collis, Betty
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ABSTRACT

This essay considers several areas of research in computer technology for education in North America and the implications of these areas of focus for the implementation of educational computer technologies in developing nations. The five areas of focus are: (1) curriculum integration, or the general rationale for using computer technology in education; (2) the use of applications software as instructional tools; (3) telecommunications; (4) implementation constraints, including teacher training and their levels of concern; and (5) the influence of contextual variables, or the "environmental press" on the impact of technology (i.e., the interaction of the characteristics of the particular computer-related material itself with those of the teacher, students, and the physical and philosophical organization of the learning environment. A review of the literature suggests that these five areas of research may have transfer value to developing nations. It is concluded that emphasis on computer-related technology as a curriculum-related tool rather than as a vocationally-oriented tool seems generally valid for school environments in developing countries as well as in more developed countries. (23 references) (EW)

Relating North American Experiences With Computer-Related Technology in Education to Developing Countries

Betty Collis
Department of Psychological Foundations
Faculty of Education
University of Victoria
Victoria, British Columbia, Canada

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Selected Focuses of North American Research and Development Pertaining to Computer-Related Technology in Education

The North American experience with respect to issues relating to the application of computer-related technology in education is difficult to synthesize because of its sheer abundance. The task is even more difficult if "experience" is defined broadly to encompass disciplined inquiry associated with development, implementation, and evaluation work involving computer-related educational technology. However, at least five general areas can be identified where some consensus may be emerging or at least where considerable energy is being directed.

Curriculum Integration

The first of these relates to the general rationale for using computer-related technology in education. When microcomputers first made a wide-ranging impact on North American education, it was very much in the context of national and personal imperatives relating to workplace success. "Computer literacy," or rather, computer illiteracy, was the "next crisis in American education" (Molnar, 1978) and both the nation in general and the student in particular were thought to be seriously disadvantaged in a technology-dominated work world if schools did not ensure their students were computer literate. This vocational-success orientation has now largely faded as an overt motivation for the application of computer-related technology in education, partly influenced by careful analyses of characteristics of the future workplace in North America (Levin & Rumberger, 1985) and partly by a reaffirmation of the primal importance of fundamental competency areas such as communication skills, inquiry skills, and numeracy skills as targets of school activity (Tucker, 1985). Associated with this has been a switch in the dominant rationale for the use of computer-related technology in education, away from an interest in the computer as a springboard to future vocational success and toward the computer as a curriculum tool (Collis, 1988). Searching for and validating strategies for employing computer-related technology as a tool within the context of traditional areas has become a major focus for North American developmental work; accompanying this has been a rapid decline in

interest in "computer literacy" and, in particular, programming as discrete instructional targets.

Applications Software as Instructional Tools

Another major trend in North American deployment of computer-related technology in education relates to so-called "applications software"; generic, tool-type software such as word processors, data base management software, spreadsheets, and more recently, telecommunications software, and desktop publishing tools. Although software specifically designed for educational purposes still proliferates, there is general acceptance of the value or at least the attractiveness of applications software as curriculum-related support tools (Lockheed & Mandinach, 1986).

Telecommunications

Although not yet supported by much outcome-oriented research or evaluation, there is a substantial interest throughout North America in employing telecommunications in the educational setting. This employment may be with respect to curriculum-related student-to-student contact (Tinker, 1987; Treloar, 1986), to student access of on-line informational data bases, to transmission of entire courses to off-site students, or to messaging or conferencing more generally as educational experiences. There is considerable enthusiasm about the potential of telecommunications in education and there are considerable resources being expended on the start-up phases of telecommunications-related educational enterprises. As yet, however, there is little systematic evaluation of the assumptions underlying this activity or the impact of the activity on learning and teaching.

Implementation Constraints

Out of the accumulated experiences related to teacher utilization of computer-related technology in education, a recognition is emerging that actual implementation is more difficult than expected (Fullan, Miles, & Anderson, 1987) and that the potential of computer-related technology is far from being realized in practice (Pea & Sheingold, 1986; Walker, 1986). A simplistic explanation for this is that there is not yet enough hardware, software, or teacher training available; however, there is increasing awareness that implementation barriers will not necessarily be reduced through more expenditure of money on a greater quantity of resources. Instead, recognition is being given to the hierarchy of "levels of concern" that teachers may

predictably face when confronted with an innovation (Hall, Loucks, Rutherford, & Newlove, 1975) or to the general systematic impediments confounding the diffusion of an innovation in the educational setting (Rogers, 1983).

Contextual Variables

Finally, the influence of contextual variables, or "environmental press," on the impact of any technology on educational experience is increasingly acknowledged (Theisen, Achela, & Boakari, 1983). The effectiveness of computer-related educational activities cannot be predicted in the abstract; it is a function of the interaction of the characteristics of the particular computer-related material itself with those of the teacher, the students, and the physical and phhlosophical organization of the learning environment (Collis, Walker, & Grant, 1987). The extent to which any particular component of this functionally related system in which computer-related educational experience is embedded can dominate the functioning of the rest of the system is only yet beginning to be systematically explored.

Application to Developing Countries

These five areas of focus or consensus in North American activity with respect to the employment of computer-related technology in education have definite implications for policy makers and planners in developing countries working for maximized effectiveness of available technologies in their own educational systems. Some of these implications will be discussed relative to each of the five focuses.

Motivation for Computer-Related Technology in the Educational Systems of Developing Countries

The primary motivation underlying the utilization of computer-related technology in education settings in developing countries may be no more well defined than the desire to "think modern" as "an indispensable skill for moving people out of traditional settings" (Laboratory of Comparative Human Cognition, 1986). It also can be broadly generalized to reflect either a "job-based model" where appropriate technology is that which relates to vocational training and the stimulation of employment opportunities; or a "systems-based model" focusing on more comprehension basic needs, such as the amelioration of needs related to literacy and quality of life more generally (Hackbarth, 1985; Logan, 1982). This classification can be further refined to reflect more variation among educational systems in developing

countries based on the function and selectivity associated with those systems. For example, Theisen, Achola, and Boakari (1983) identify "sponsored mobility systems," with children of upper-class parents having greater access to higher education ("de facto elitist"); "contest mobility systems," where persistence and ambition can be realized in the completion of tertiary degrees for the motivated individual; "education for liberation" systems, where the orientation is on socialization and social transformation, often associated with a reaction against "the kind of class-based and educational inflation" (p. 45) associated with colonial education; and "predetermined labor quota systems," where managerial and technically oriented manpower is highly rewarded by the system. It is clear that such a diversity of cultural contexts precludes any simple generalization about what orientation is most appropriate for developing countries with respect to computer-related technology deployment in education. However, it does appear justifiable to recommend a curriculum-referenced orientation as opposed to a job-training orientation even for countries with relative job-based models of education. The same arguments against a job-based approach in North America--that most jobs do not require computer-related skills and that those that do can either supply training for the skills at the workplace or alternatively will require highly trained specialists (Levin & Rumberger, 1985; Oliveira, 1988)--also pertain to developing countries. Education in basic, curriculum-related skills "seems to be at least as important as specific computer techniques" (Oliveira, 1988) for the general welfare of both the individual and his or her society in either more or less developed countries.

Applications Software as an Educational Resource for Developing Countries

Murray-Lasso (1988) underscores a critical issue with respect to utilization of computer-related technology in developing countries when he comments on the chronic undersupply of software in these countries in the context of "extreme scarcity of funds" and "cultural constraints." Mexico, for example, "will not accept culture-dependent computerized educational materials that were developed for other cultures." Harper (1985) concurs in the importance of native-language, culturally sensitive material, and Wambi (1988) offers a "third world perspective on technology transfer" by expressing great concern about the transplanting of other, more industrialized cultures through the absorption of their communication systems. He sees technology as being "like genetic material--it is encoded with the characteristics of the society which developed it and it tries to reproduce that society"

(p. 24). The general response to this concern about cultural integrity is to advocate locally produced materials including software. However, the production of educational software is a lengthy and expensive task with little or no hope of economic payoff or of more than highly limited output after a considerable investment of time and resources. Although such local development may be a long-range possibility in certain developing countries, it does nothing to help the immediate need for culturally and economically appropriate software. Applications software, although admittedly "genetically encoded" with the imprint of industrialized countries, is not overtly culturally biased. Native-language versions of these basic generic tools either already exist or could be produced in a reasonably straightforward fashion from an English-language version. In their application, they only manipulate what the user enters, thus minimizing problems of cultural perspective in the content of the software. (This assumes there are adaptations available for the specialized character needs of the alphabets of specific developing countries.) Teacher familiarization can be expedited as well, if a basic set of generic tools forms the core of initial teacher training activities. Public domain generic tools, at least for word processing and data base management, are commonly available at little or no expense (Hadley, 1986), thus helping to ameliorate the cost problem.

Telecommunications as a Resource Provider in Developing Countries

Telecommunications has considerable long-range potential as a resource provider for countries with inequitable access to information and resources. Access, for example, to on-line informational data bases requires only a single hardware system in a school (although admittedly, it also requires affordable telecommunications system access, as yet unavailable in more than an isolated fashion in developing countries--and not much more conveniently in developed countries, either). However, the potential still does exist to bring training and educational resources to areas which could not supply them otherwise. Problems of cultural and language transmission emerge immediately, yet the potential value is sufficiently strong that aggressive exploratory efforts seem warranted.

Implementation Barriers in Developing Countries

An important issue suggested by models such as Rogers' (1983) and Hall, Loucks, Rutherford, and Newlove's (1975) relating to implementation of an innovation in an educational system relates to a developmental perspective. Are there stages of experience

that need to be gone through by teachers and institutions and systems as a whole before these entities can meaningfully internalize the implications of each stage and move on to the next? Or can groups (or countries) with more experience transmit to groups (or countries) with less experience the lessons they have learned through their own evolution? Can developing countries skip the early stages of exploration and abandoned activities on which North American and European systems have spent considerable time and money, and instead build directly from these experiences? The diffusion literature (Rogers, 1983) and the "levels of concern" model of institutional absorption of an innovation (Hall, Loucks, Rutherford, & Newlove, 1975) suggest that a developmental sequence might need to be respected within developing countries as they work through their own assimilation period with respect to computer-related technology in education. This might mitigate directly against large-scale advocacy of telecommunications usage, for example, even though such usage is occurring with good effect in more developed countries in that teachers and systems at an early level of experience with computer-related technology in their classrooms may just not be "developmentally" ready to exploit the potential of the medium given its technical challenges and its general utilization of integrated or cooperative activities.

Contextual Constraints in Implementing Technology Into a Different Culture From Which It Was Originally Developed

Concern about attempting to implant foreign technology into the different "ecocultural framework" (Laboratory of Comparative Human Cognition, 1986) of schools in developing countries is well known. Wambi (1988) notes that the alienation that this can promote relates to more than communicative language; it is more profoundly a "silence that is political, technical, and ideological" (p. 24). Others, however, are more optimistic about the contextual problem. Joyce and Showers (1985), for example, report that of more than 80 studies focusing on the implementation of Western innovations in the Indian educational system, the experience the Indians have had with the innovations "approximated the North American findings." They note that, "when innovations are implemented solidly enough that they can be evaluated, which is usually in the leading [educational] institutions, they appear to translate very well" (p. 6). It is true that Joyce and Showers were talking about innovations in teacher education generally rather than with respect to computer-related technology; however, their perspective is encouraging. Harper's (1985) frustrating experiences while conducting teacher education courses in Malaysia and in Papua New Guinea are probably more like the norm in

attempts to utilize Western technology in developing countries. Potentially more important though than anticipating cultural differences in school environment and practice is the perspective that intranational contextual differences in developing countries critically influence the impact of technology in education just as they do in more developed countries (Theisen, Achola, & Boakari, 1983). Teacher-related, student-related, and organizationally related variables preclude any straightforward expectation of success for applications of computer-related technology in developing countries similar to the way they do in more developed countries. As Pea and Sheingold (1986) observe, "educational technologies serve as mirrors of mind and the cultures in which they 'live.' Rather than radically amplifying or transforming the processes of teaching and learning, as many expected, they instead reflect the expectancies represented in classrooms and the knowledge and skills of individuals using them" (p. x). Cautioning policy makers and teachers in developing countries against unrealistic expectations about the direct contribution of computer-related technology in their educational institutions can help in a variety of ways, as for example, in recognizing that developing instructional models for teachers may be a wiser use of scarce resources than the purchase of more hardware and software. If leaders in developing countries can learn from some of the costly experiences with little payoff that have occurred in North American schools because of a lack of sensitivity to the impact of contextual variations on the effectiveness of computer-related technology, then the potential for more appropriate use of technology in a more cost-effective manner may be advanced.

Summary

We have considered five areas of research or active investigation in North America within the general context of the application of computer-related technology to education. Although generalizations must be made conservatively, consensus in each of these areas may have transfer value to developing nations. Emphasis on computer-related technology as an instructional, curriculum-related tool rather than a vocationally oriented training tool seems generally valid for school environments in developing countries as well as in more developed countries. However, this does not preclude the separate development of training programs where job-specific skills can be simulated or directly learned via a computer-related medium. The integration of applications software into classrcom contexts seems a particularly powerful recommendation for developing countries, in that the advantages supported in more developed countries with regard to generic tools without age or subject matter restrictions

also pertain, but in addition, applications software can be less culturally saturated than tutorial or content-oriented software and is arguably more cost-effective. The vision that motivates the advocacy of telecommunications as a tool to "remove the classroom walls" and help "build the global village" holds even more potential value with respect to reducing inequities of resources and opportunities in developing, remote, or disadvantaged areas. However, the technical feasibility of telecommunications access may preclude its cost-effectiveness or even availability in the immediate future in developing countries. In addition, the conceptual sophistication associated with the use of telecommunications as an effective learning medium may not correspond with the level of experience or concern shared by the majority of teachers in countries where exposure to technology is less widespread than it is in the more developed countries. Finally, the difficulties which constrain the diffusion of computer-related technology in more developed countries and the way in which subtle as well as obvious conceptual variables can limit its educational effectiveness provide important lessons for those who seek to implement similar technologies in developing countries. In particular, the critical role of the teacher, not the hardware or software, is likely to be generalizable, both intranationally and internationally.

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